How to evaluate the chromatic integration of architectures with visual impact on the landscape by using objective and subjective indicators: state of the art.

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ABSTRACT

We analyze the main indicators, both *objective* and *subjective*, that specialists have proposed to assess the visual integration degree of an architecture which has a high level of impact on urban or natural landscape. So far, most of the legislation on this issue mainly concerned industrial and energy installations in natural environments. However, more recent Spanish legislation (LOTPP 2004, RPCV 2006, etc.), like many others in the European Union do, demands considering some other architectural settings, such as the urban edges, the roads into city, or the cultural heritage environments. This requires developing a 'landscape integration study' with civil participation, in which color has to be evaluated as a conditioning aesthetic fact, but regulations do not give specific guidance on how to evaluate such a feature. Research on visual integration developed for industry; usually assess in an objective manner the impact of color by calculating an index based on the difference between the average color of the element to be integrated and the one of the background. However, the work of artists and architects demonstrate that there exist many other visual integration strategies which are worthy and are not based on color matching.

1. INTRODUCTION

This paper is part of an ongoing research project entitled: "Strategies to improve the visual integration of architectures with impact on landscape, based in chromatic criteria", founded by the Polytechnic University of Valencia (UPV, PAID-06-2012). The main objective of the project is to find chromatic strategies, different to the colour matching between figure and background, to improve the visual integration of buildings with high-impact in urban or natural landscape, and affirm other artistic possibilities to reduce the visual impact of architectures in landscape different to the idea of 'disappearance'.

In this paper, we analyze the state of the art in relation with those indicators, both *objective* and *subjective*, that different researchers have used to better reach the visual integration.

1.1 Colour in landscape integration regulations

Taking into account the landscape regulations, Spanish government has the obligation to *"maintain and enhance the scenic and cultural quality of the urban environment by regulating (...) the use of materials, textures and **colors** suitable for the formation of the visual environment"*.[1] This legislation is developed in other Decree[2] that describes the

[1] Art. 28b, Ley 4/2004, de 30 de junio, de la Generalitat, de Ordenación del Territorio y Protección del Paisaje, LOTPP

[2] Art. 36, Decreto 120/2006, of August 11, of the Consell, by which approves the "Reglamento de Paisaje de la Comunitat Valenciana" (RPCV).

contents of a *Visual Landscape Analysis*, which requires a *Public Participation Plan* (Art. 17.2, RPCV).

Spanish regulation considers that architectures produce landscape and visual impact when they *"differ and contrast significantly from the environment where they are located, and reduce the visual landscape value because of its size, volume, composition, type, texture, color, shape, etc."* (Art. 50, RPCV)

In any case, the color is a key aesthetic variable, recognized in the international literature, as well as subsidiaries standards of most municipalities (Cañas-Guerrero 1994), as well as in the Territorial Action Plan of the city of Valencia [*Plan de Acción Territorial de la Huerta de Valencia*], which includes a public participation process.

2. AESTHETICH INDICATORS

It exists an extensive literature regarding visual integration of infrastructure and industrial facilities in natural environment: (1) agro-industrial buildings (Garcia, Hernandez et al. 2003), (2) farms, (3) wind power plants (Ladenburg 2009), (4) Photovoltaic (Chiambrano 2009), (5) high voltage lines (Sumper et alt 2010), etc. However, it is smaller the number of studies regarding visual integration of architecture in landscape (O'Connor 2008), and scarce in urban settlements (Unver & Ozturk 2002) and ancient city centres.

We try to differentiate two types of visual indicators: *objective* and *subjective*. Objective indicators refer to those quantitative facts that may be distilled from the image of the settlement and are somehow measurable in a quantitative manner, following a positivistic research methodology. Although *objective indicators* could be based on the perception of observers, they aim to be useful for a kind of ready-to-use formulae. *Subjective indicators* refer to those qualitative interpretations based on people different ways of understanding the architectural integration and their meanings.

At the end, our research would like to demonstrate that *objective indicators* in relation to colour contrast/ harmony are always a first step to approach the problem of the architectural integration, but are many times overwhelmed by other *subjective indicators* that could contradict the starting point of view. The work of artists and architects demonstrate that there exist many visual integration strategies which are worthy and are not based on colour matching, or a perfect mimesis (Figures 1, 2). Contemporary architecture, in fact, moves between mimesis and singularity (Serra 2010).

2.1. Objective Indicators

Most of the research about visual integration uses different possible colour interventions for the same building and evaluates a first colour contrast analysis by *objective indicators*. These objective indicators are based in the difference between chromatic attributes of the colours of the building in contrast with those of the surroundings: differences in RGB notations (O'Connor 2008); Munsell's Hue, Value and Chroma quantities (Unver & Ozturk 2002), etc.

Considering photographs, Torres-Sibille (2009) proposed an objective indicator of the *aesthetic impact* of various industrial facilities in the landscape. This is an indicator that integrates five variables: *visibility, color, fractality*, *concurrency* and *weather conditions*, and that was contrasted with subjective indicators using the semantic differential method. The indicators were validated with three different groups of individuals: designers during the design process (*Sui validatio*) researchers to validate the result (*Scientatis validatio*)

and end users (*Societatis Validatio*) (Cloquell et alt 2006 Bockstaller 2003). However, the aesthetic impact indicator because of the colour has some limitations, since it consists solely of calculating the average colour difference between figure and ground following the CIELab* 1974 colour difference formula [AE * = "√ (" (Δ L *) ^{2} + (Δa *) ^{2} + (Δ.b *)^2)], a method that could be useful for industrial facilities in landscape, but which seems insufficient for architectures in urban environments.

Figure 1: DREWAG Stadswerke. Ev Garnier, Dresden, 2005.

Figure 2: Südzucker AG Mannheim/ Ochsenfurt. Ev Garnier. Dresden, 2005.

2.2. Subjective indicators

It has been noted that the law requires public participation processes in writing integration projects landscape. There are several proposed methodologies (Mohanty and Tandon 2006),based on the use of images as usual type of stimulus.

The use of the semantic differential method has been widely used in industrial design, but also in architectural spaces (Kuller 1991). Kuller used antonyms bipolar Likert scales to assess perceptions of observers in environments using architectural concepts: *Pleasantness*, *Complexity*, *Coherence*, *Openness*, *Affection* and *Originality*, which various authors add others as *Naturalness* and *Liveliness* (Real et alt 2000), *Stimulation* (Desmet 2003) and *Protection* (Torres-Sibille et alt 2009). O'Connor (2011) develops a very interesting research comparing judgements about the apparent size, visual dominance and congruity of buildings.

The *kansei* methodology is somehow new for architecture, as it establishes a framework for working with symbolic attributes and perceptions of the users expressed in their own language. Its advantage is that it allows quantifying the relationship between the design characteristics and the emotional response (Nagamachi 1995).

3. A POSSIBLE CLASIFICATION OF COLOUR INTEGRATION STRATEGIES IN ARCHITECTURE

As a necessary part of Kansei methodology, we will have to classify different *stimuli*, these are photographs with different possible colour interventions onto architectures, to evaluate their integration degree. Starting with *objective indicators*, we will classify the stimuli in three groups (mimetic, harmonious and contrasting) and will compare them with the *subjective indicators* (assessments by observers) to evaluate their coherence.

Artistic strategies based in chromatic *mimesis* consist of approximating the color of the building to the background, trying to get their color difference the smallest possible. The distorting element is colored to be invisible, if this is possible (Figure 3).

Figure 3: Roeland Otten, Dazzle Painted Electricity Substation, 2012.

Artistic strategies based in chromatic *harmony* display colours onto the distorting architecture not to make it dissapear, but to make congruent with the surroundings. Colours in this case are used to transform the perception of the size, geometry, weighth, rithm, or whatever visual property of the form.

Artistic strategies based in chromatic *contrast* use colours that substantially differ from those of the surroundings, assuming the discrepancy as a possible way of aesthetic integration.

The classification proposed is similar to the one by García, Hernández and Ayuga (2006), describing three posible visual relations between building and environment: *visual continuity*, *diversity* and *contrast*; following in some way Gestalt's oponent visual concepts: *levelling* vs *sharpening*. Spillmann (1985) outlines the possible relationship of buildings to their surroundings with a more accurate classification: *camouflage*, *subordination*, *equal ordination*, *superordination* and *isolation*. All these authors conclude that it is both necessary a visual colour continuity between the architecture and the surroundings, but also a certain contrast "wich produce tension and change: "unity in variety or continuity in complexity" (Spillmann 1985 p6)

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